A Qualitative Comparison of Shoreline Biota in Central Puget Sound After 25 Years

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Many shoreline sites in central Puget Sound inventoried in 1999 by DNR's Nearshore Program were previously sampled in the 1970s. We compared these datasets to examine long-term change in the biota of mixed-coarse (cobble-pebble-sand) beaches. While methodological differences preclude quantitative comparisons, general patterns emerge. Overall, the types and relative abundances of animals (epifauna and infauna) were quite similar among times. Some of these similar organisms include taxa ubiquitous in this common Puget Sound habitat type, but others comprised uncommon species present through time at the same few sites. Other organisms were dissimilar among times, many because of methodological differences (e.g., core depth, sieve size), others with no obvious explanation. There were no trends in the types of taxa (e.g., particular feeding modes) that changed through time, which might have suggested cause for concern. The only clear discontinuity between time periods was in the Point Wells/ Richmond area. Here, the 3 sites sampled in 1999 showed a striking reduction in abundance of taxa relative to 1970s surveys, and were also different from beaches both to the north and the south in 1999. A variety of human impacts or physical changes could be responsible for this trend.

Seed Production of *Spartina anglica*, A Non-Native Cordgrass Colonizing Intertidal Habitats of Puget Sound, Washington

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Abstract

Spartina anglica (Poaceae) is an invasive cordgrass that was introduced into Puget Sound in the early 1960s and has since spread across approximately 3,000 ha of intertidal habitat. Utilizing seeds and vegetative reproduction, *S. anglica* is capable of rapid dispersal and establishment within a variety of Puget Sound shoreline habitats. Despite the importance of seeds to the colonization of *S. anglica*, little is known about patterns of seed production in Puget Sound. During the summer and fall of 2000, *S. anglica* spikelet maturation (50 spikelets per sample, n=8 samples per locality) was monitored at nine Puget Sound locations. Seed viability was not assessed. The mean percentage of filled caryopses (one seed per caryopsis) ranged from 23% to 70% at the nine locations. Mean spikelet weight per 50 spikelets ranged from 0.27 g to 0.88 g. Using analysis of variance and Tukey's Test for pairwise comparisons, differences ($p<0.05$) were detected in filled caryopsis percentage and spikelet weight between habitat types and localities. Low salinity marshes (n=3) produced the most filled caryopses (66%) as well as the largest spikelets (0.74 g) compared to high salinity marshes (n=2; 36%, 0.46 g) and mudflats (n=4; 55%, 0.43 g).

Two localities where the herbicide glyphosate had been applied for *S. anglica* control also were examined for seed maturation, but not for seed viability. At Maylor's Marsh (Island County), *S. anglica* caryopsis maturation was greatly reduced (p=0.0001) in sites treated with glyphosate (3%) compared to untreated sites (49%). However, at Livingston Bay (Island County), glyphosate had no effect (p=0.46) on filled caryopsis production (48% and 54% for herbicide and untreated sites respectively). These differences can probably be explained by the timing of the glyphosate application in relation to inflorescence development of *S. anglica*.

Ongoing Invasion of the Asian Purple Varnish Clam, *Nuttallia obscurata,* into Puget Sound Waters: Does Anyone Care?

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Nuttallia obscurata is believed to have arrived in the Strait of Georgia region in ballast water in the late 1980s and was first collected in 1991, just north of the Canadian border. It spread very rapidly throughout the southern Strait of Georgia, but is moving more slowly south into Puget Sound. I have been studying this clam since late 1997, primarily in San Juan County, where it has become common in the upper mid intertidal - localized densities can exceed 500/m^2. It occurs in sediments ranging from cobbles to muddy sand, above (in tidal height) or near the native littleneck (*Protothaca*) and earlier-introduced Manila (*Venerupis*) and softshell (*Mya*) clams. *N. obscurata* is native to Japan, Korea, and perhaps China—its distribution is somewhat unclear because of historic taxonomic confusion among closely related species in Asia. It is not valued as a commercial species and apparently does not appear in markets in Japan, although it is eaten locally there. A map of its known occurrence throughout Puget Sound will be presented; most sites are north of Edmonds. It is also present on the outer coast in a few locations from Barkley Sound, Vancouver Island, to central Oregon.

Statistical Trajectory Analysis of the Seeds of Common Cordgrass *(Spartina anglica)* in Northern Puget Sound

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Common cordgrass *(Spartina anglica)*, an invasive exotic, is a vigorous hybrid capable of competing with native saltmarsh vegetation, and colonizing intertidal mud and sand flats. From an innocuous 15 acres in 1979, *Spartina* has spread to 42 known location and covers over 600 solid acres as of 1997. The ability of *Spartina* seeds to colonize relatively distant sites makes a thorough survey and inventory of Puget Sound's extensive shoreline difficult.

The spread of the seeds of *Spartina* in northern Puget Sound was Statistically analyzed using two of NOAA/HAZMAT's spill models: OSSM (On-Scene Spill Model) and TAP II (Trajectory Analysis Planner). The objective was to generate probabilities that *Spartina* grass seeds originating from known colonies would beach in particular areas. This information could then be used to prioritize the treatment of

Spartina, to locate possible new colonies of the grass, to backtrack new infestations to the parent colonies, and to quantify the environmental and cost savings from previously treated colonies. To generate statistics for this analysis, 15 years (1984-1998) of wind data, tide data and river flow data from numerous locations were used. For each known *Spartina* infestation a total of 500 model runs were randomly initiated spanning the months of October, November, and December between 1984 and 1998. Each run consisted of 1000 floating particles representing the seeds. To help determine where seeds would settle, shoreline segments were tagged with different beach types from the NOAA/HAZMAT Environmental Sensitivity Index (ESI) atlases to determine how quickly seeds would refloat once they came ashore. In addition, the shoreline of the modeled areas was segmented into about 1100 segments, and statistics were compiled on how these shoreline segments were impacted, including frequency, timing, and number of particles beaching. Computational runs utilized OSSM, and the data were displayed using TAP II. The result is a Windows and Macintosh application, TAP II, that shows the probability of where *Spartina* grass seeds would end up if dispersed from known infestation located throughout northern Puget Sound